Tensorflow

What is Tensorflow ?

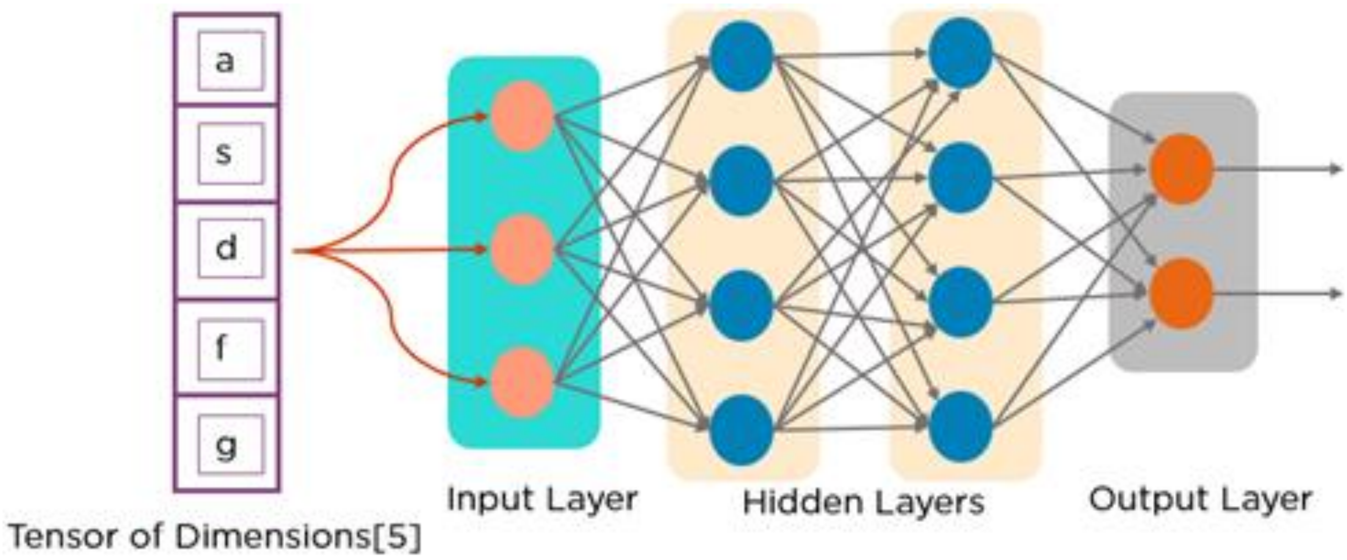
- ***TensorFlow*** is a Python-friendly open source library for numerical computation that makes machine learning faster and easier.

- TensorFlow computations are expressed as **stateful dataflow graphs**.

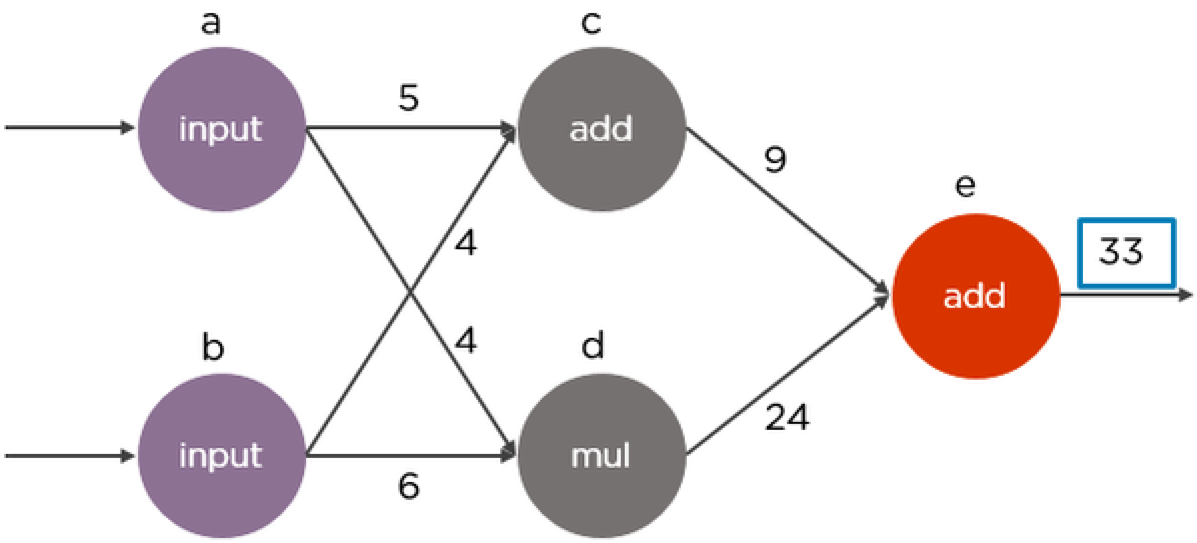
- The name **TensorFlow** derives from the operations neural networks perform on multidimensional data arrays. These arrays are referred to as "**tensors**".

- Benefits : More flexibility, Control over network model

TENSOR



DATA FLOW GRAPH



TensorFlow Background

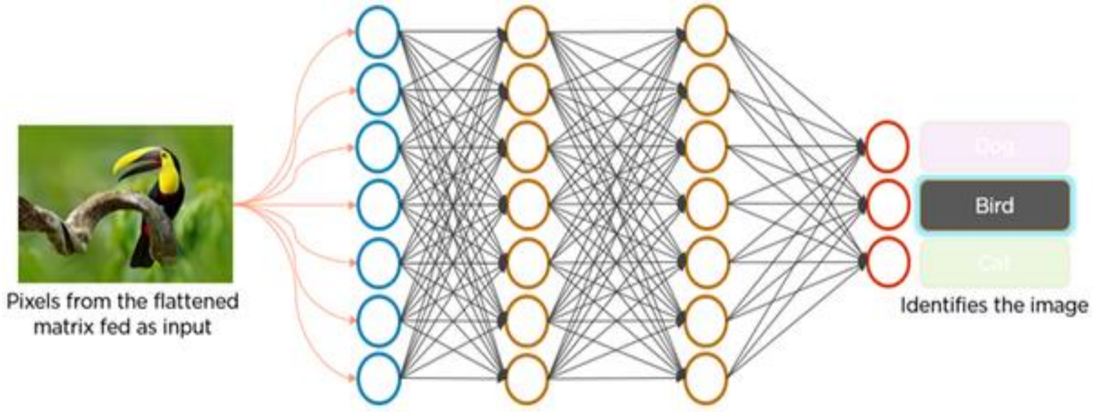
History

- Starting in 2011, Google Brain built **DistBelief** as a proprietary machine learning system based on deep learning neural networks, later became Tensorflow.

- Nov 2017,Google announced a software stack specifically for Android development, **TensorFlow Lite**, beginning with Android Oreo.

Specific problems it's designed to solve:

Computer Vision - Image Detection



Voice Recognition

Auto Translation (Google Translate)

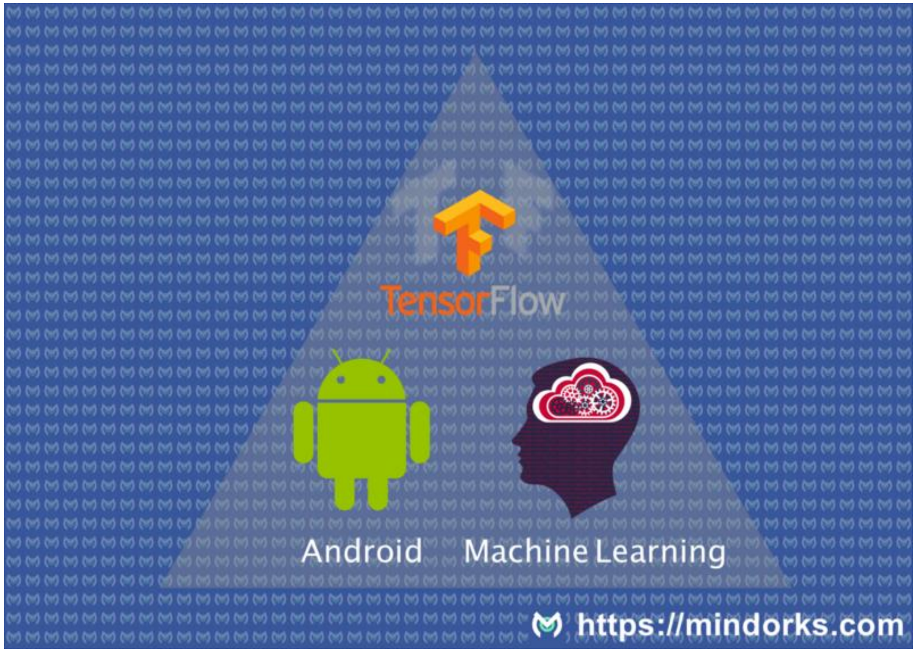
Time Series Prediction

Leverage Ubiquitous Nature

Tensorflow + Android → Powerful Android apps .

Harvest the rich sensor data available on mobile devices.

Example : Human Activity Recognition (HAR)



TENSORFLOW FOR MOBILE

TensorFlow Lite is one of the solutions for running machine learning models on mobile and embedded devices.

TensorFlow Lite

Google Developers

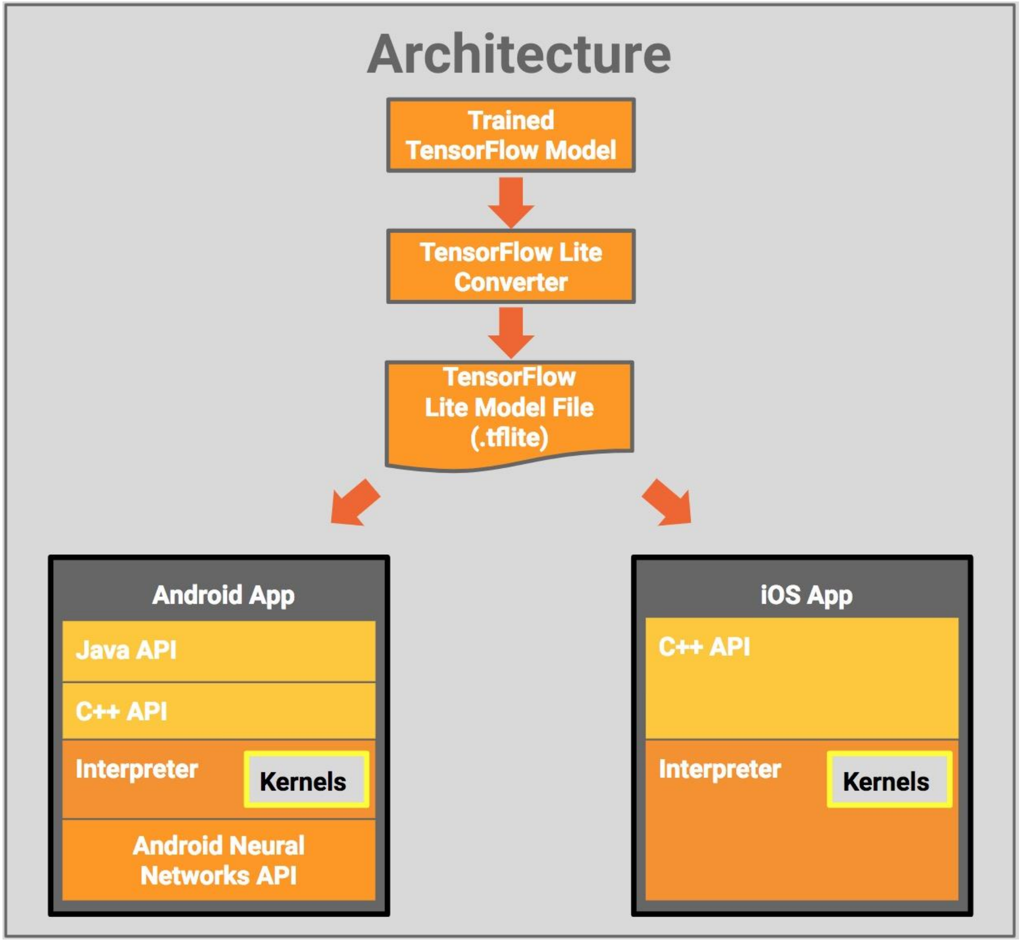
ARCHITECHTURE

- **JAVA API**:

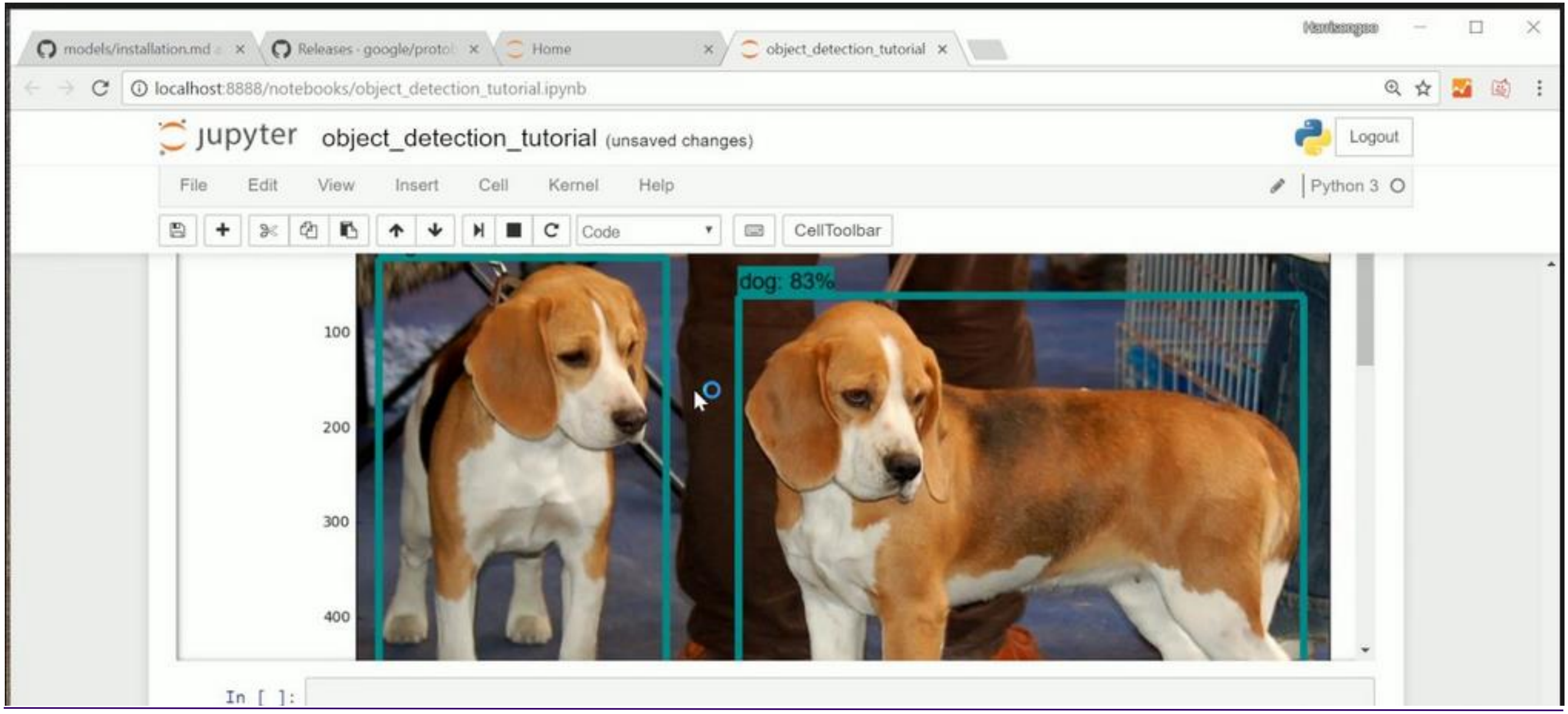
  A convenience wrapper around the C++ API on Android.

- **C++ API**:

  Loads the TensorFlow Lite Model File and invokes the interpreter.

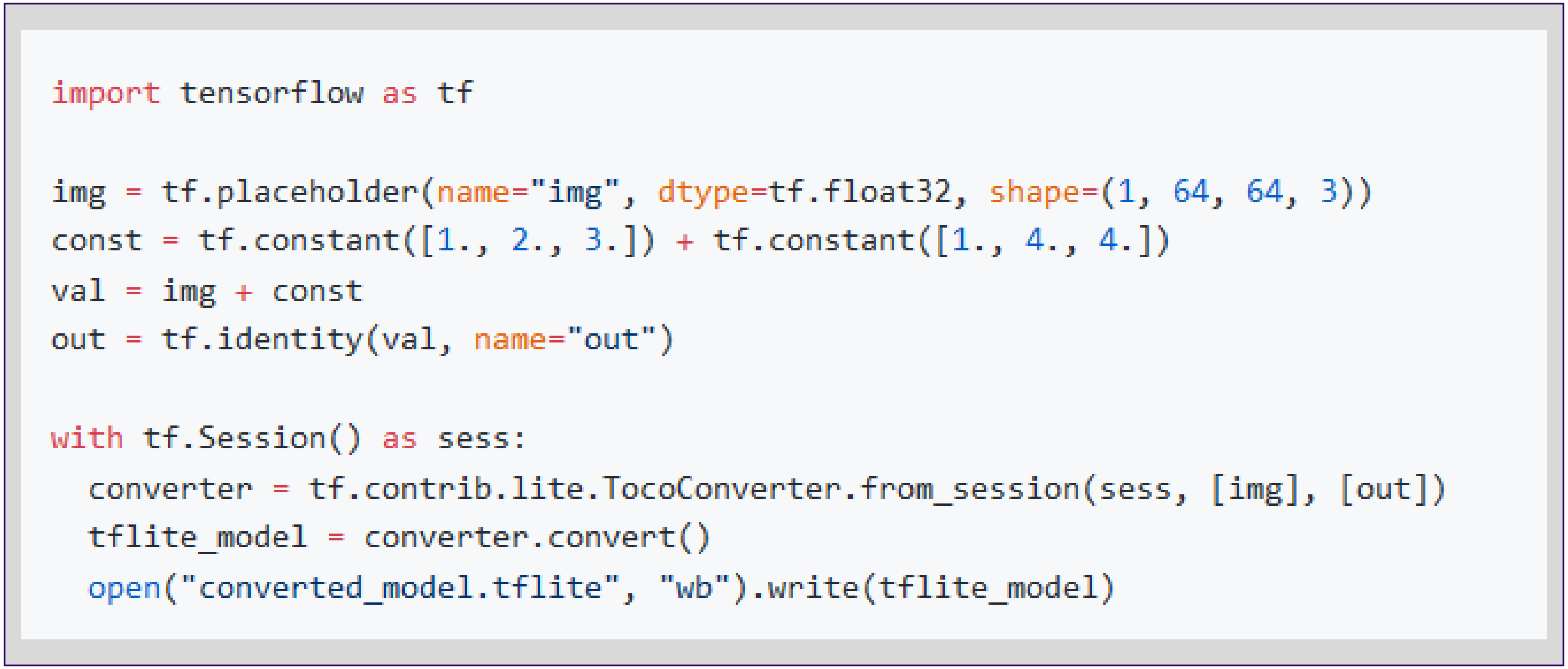


To Start : Build a model



Convert model to .tflite

Use TOCO: TocoConverter

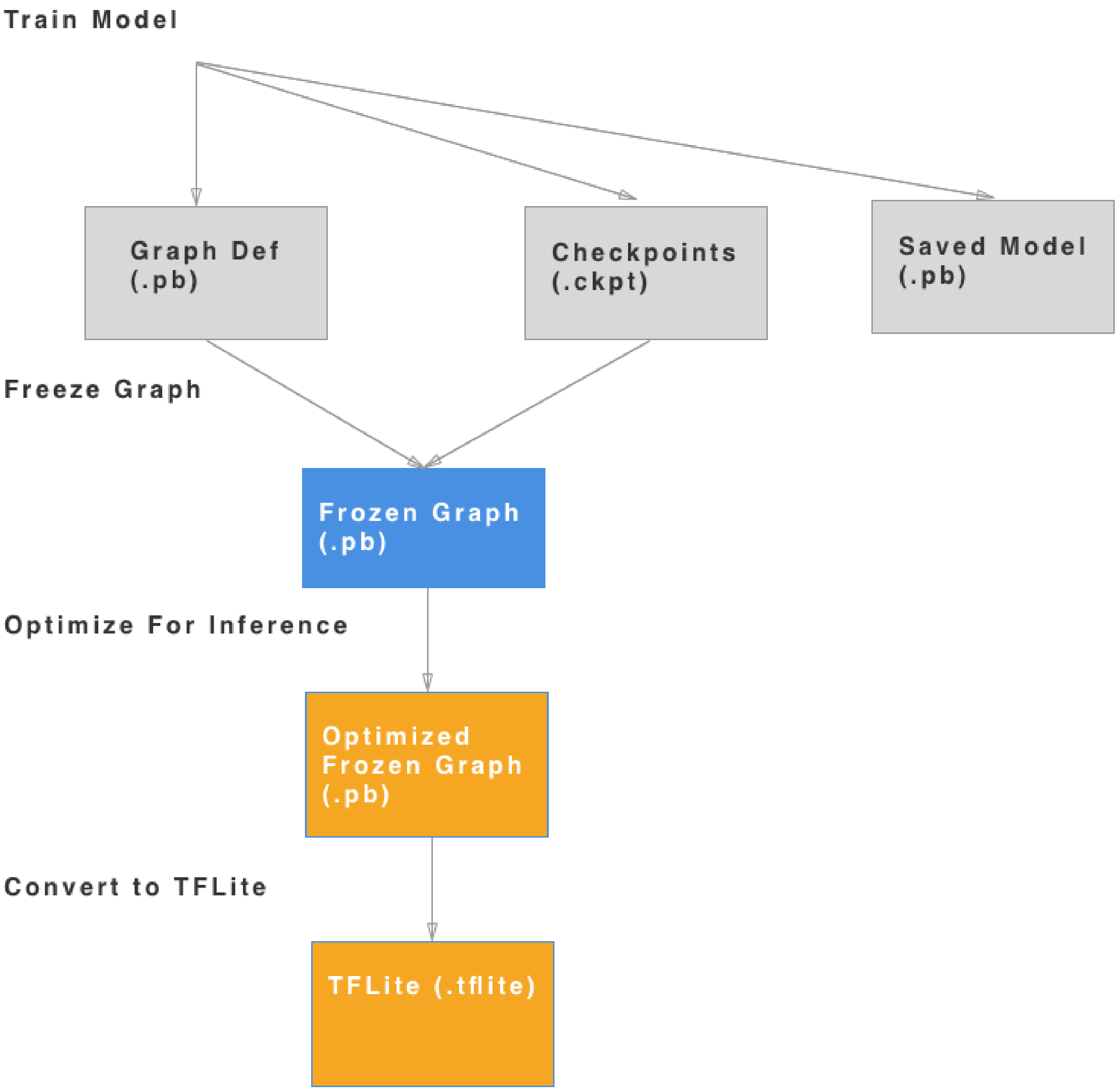


```
import tensorflow as tf

img = tf.placeholder(name="img", dtype=tf.float32, shape=(1, 64, 64, 3))
const = tf.constant([1., 2., 3.]) + tf.constant([1., 4., 4.])
val = img + const
out = tf.identity(val, name="out")

with tf.Session() as sess:
  converter = tf.contrib.lite.TocoConverter.from_session(sess, [img], [out])
  tflite_model = converter.convert()
  open("converted_model.tflite", "wb").write(tflite_model)
```

Convert model .tflite



Train Model

Graph Def (.pb)

Checkpoints (.ckpt)

Saved Model (.pb)

Freeze Graph

Frozen Graph (.pb)

Optimize For Inference

Optimized Frozen Graph (.pb)

Convert to TFLite

TFLite (.tflite)

Building an Android App with Tensorflow lite

Step 1: Add the tensorflow-lite libraries to your app.

```
compile ‘org.tensorflow:tensorflow-lite:+’
```

Step 2: Import the Tensorflow Interpreter.

```
import org.tensorflow.lite.Interpreter;
```

Step 3: Create an instance of the interpreter.

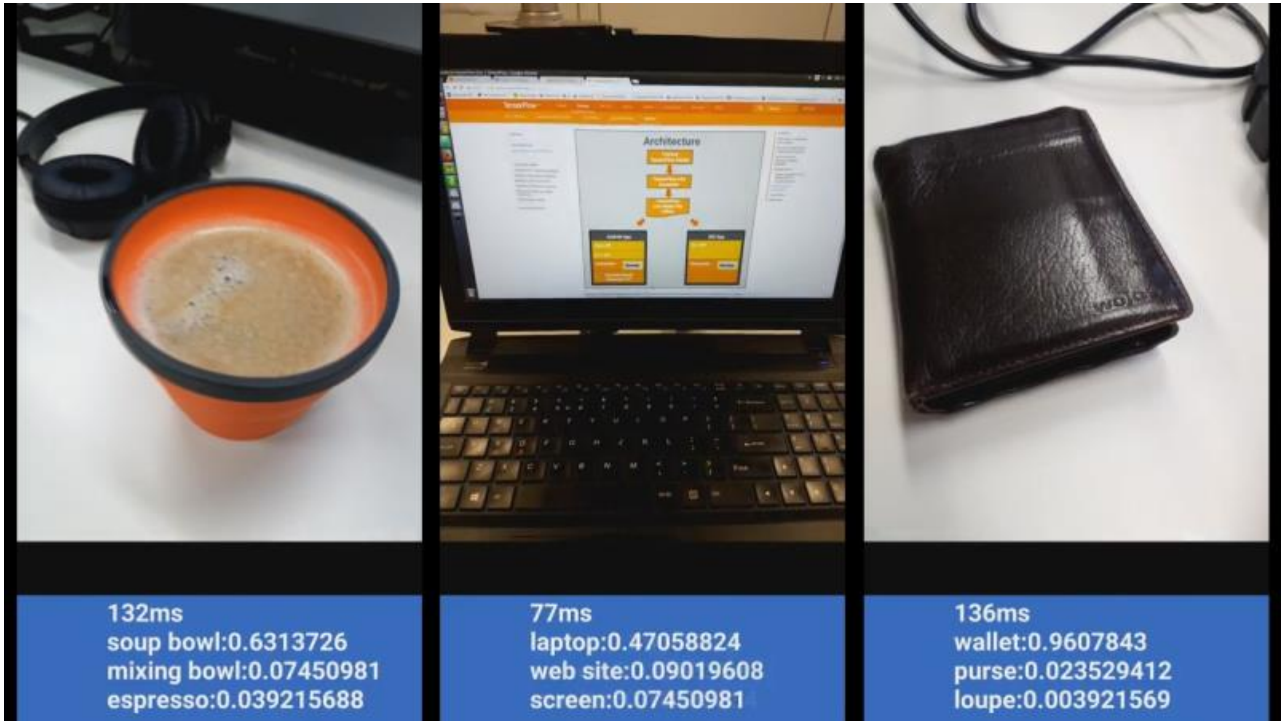
```
protected Interpreter tflite;
tflite = new Interpreter(loadModelFile(activity));
```

Step 4: Memory-map the model file in Assets.

```
private MappedByteBuffer loadModelFile(Activity activity) throws
IOException {
 AssetFileDescriptor fileDescriptor =
activity.getAssets().openFd(getModelPath());
 FileInputStream inputStream = new
FileInputStream(fileDescriptor.getFileDescriptor());
 FileChannel fileChannel = inputStream.getChannel();
 long startOffset = fileDescriptor.getStartOffset();
 long declaredLength = fileDescriptor.getDeclaredLength();
 return fileChannel.map(FileChannel.MapMode.READ_ONLY,
startOffset, declaredLength);
}
```

Step 5: Run the method on the interpreter.

```
tflite.run(imgData, labelProbArray);
```



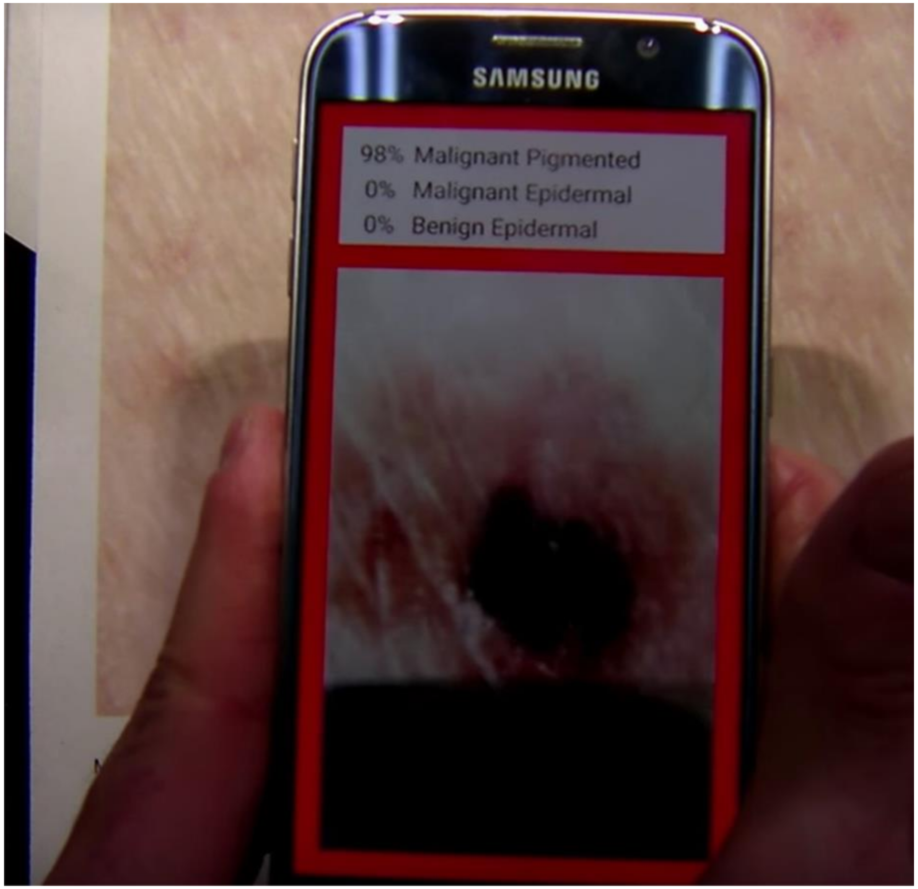
```
132ms
soup bowl:0.6313726
mixing bowl:0.07450981
espresso:0.039215688
```

```
77ms
laptop:0.47058824
web site:0.09019608
screen:0.07450981
```

```
136ms
wallet:0.9607843
purse:0.023529412
loupe:0.003921569
```

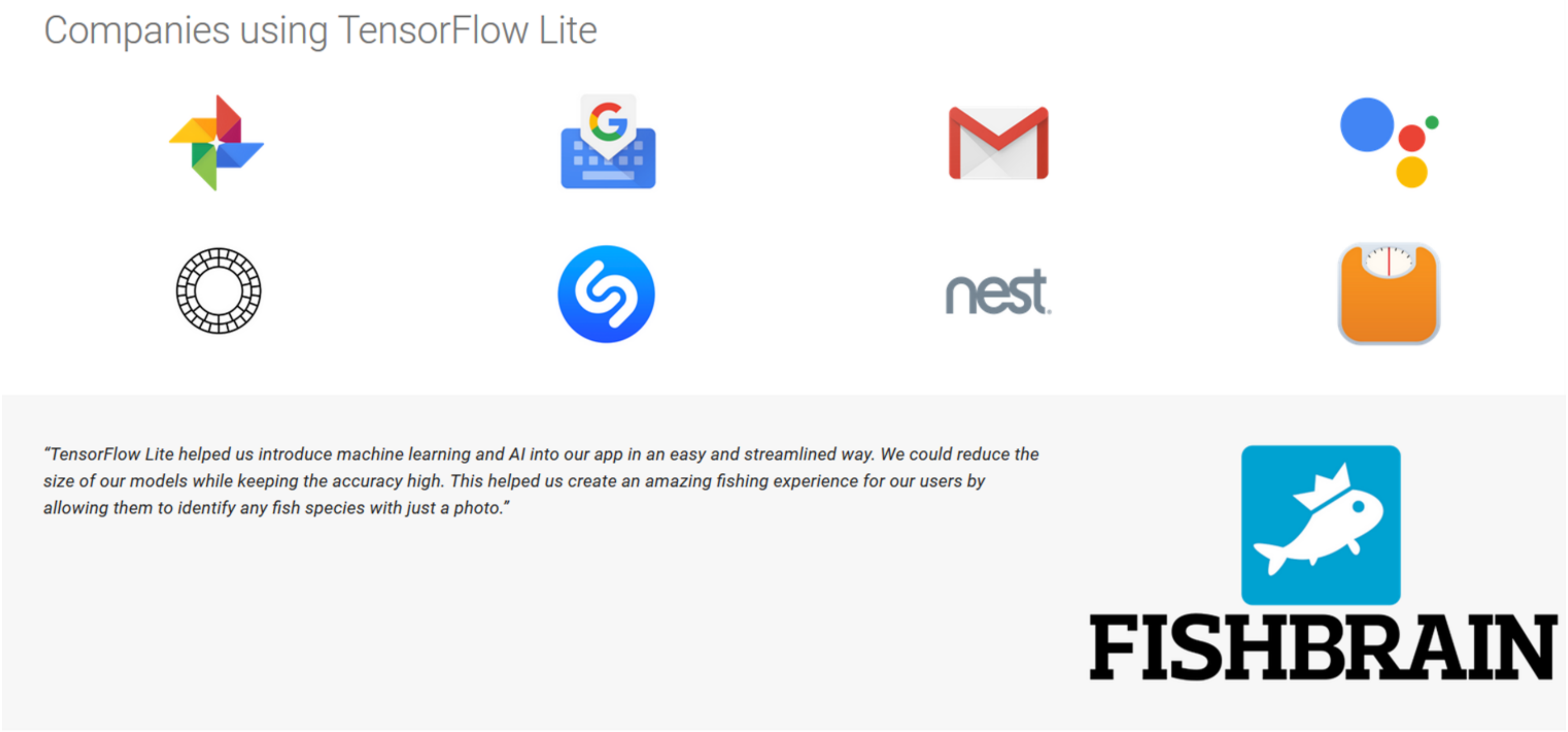
Real World Example

- Yolo
- Skin Cancer Recognizer



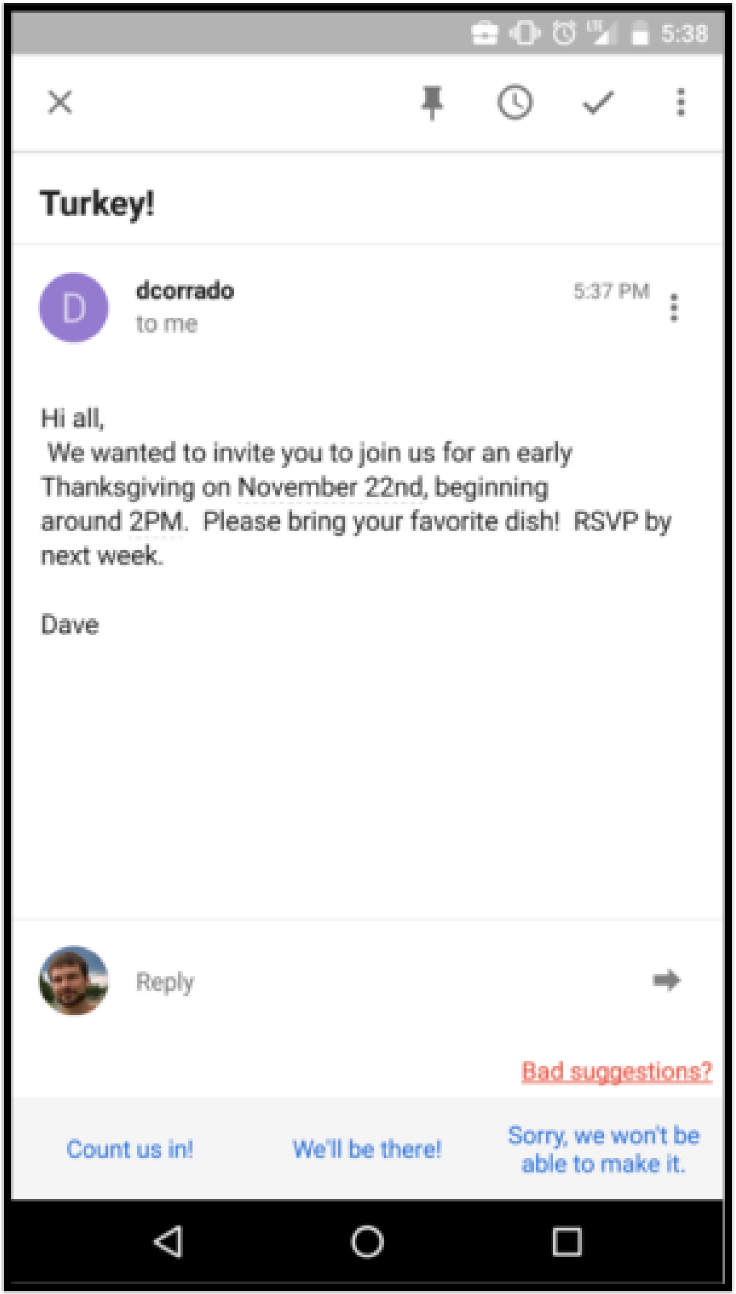
98% Malignant Pigmented
0% Malignant Epidermal
0% Benign Epidermal

Real World Example



Companies using TensorFlow Lite

"TensorFlow Lite helped us introduce machine learning and AI into our app in an easy and streamlined way. We could reduce the size of our models while keeping the accuracy high. This helped us create an amazing fishing experience for our users by allowing them to identify any fish species with just a photo."



Turkey!

dcorrado
to me
5:37 PM

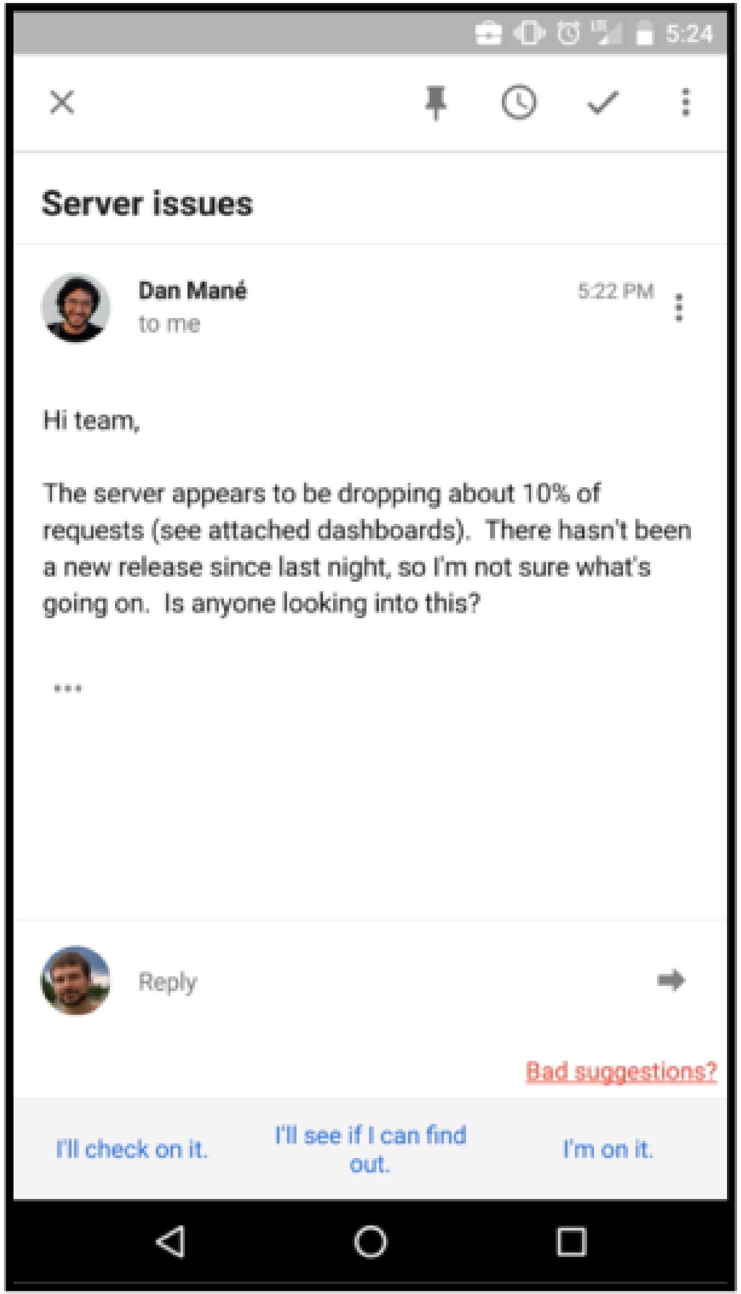
Hi all,
We wanted to invite you to join us for an early Thanksgiving on November 22nd, beginning around 2PM. Please bring your favorite dish! RSVP by next week.

Dave

Count us in!

We'll be there!

Sorry, we won't be able to make it.



Server issues

Dan Mané
to me
5:22 PM

Hi team,

The server appears to be dropping about 10% of requests (see attached dashboards). There hasn't been a new release since last night, so I'm not sure what's going on. Is anyone looking into this?

...

I'll check on it.

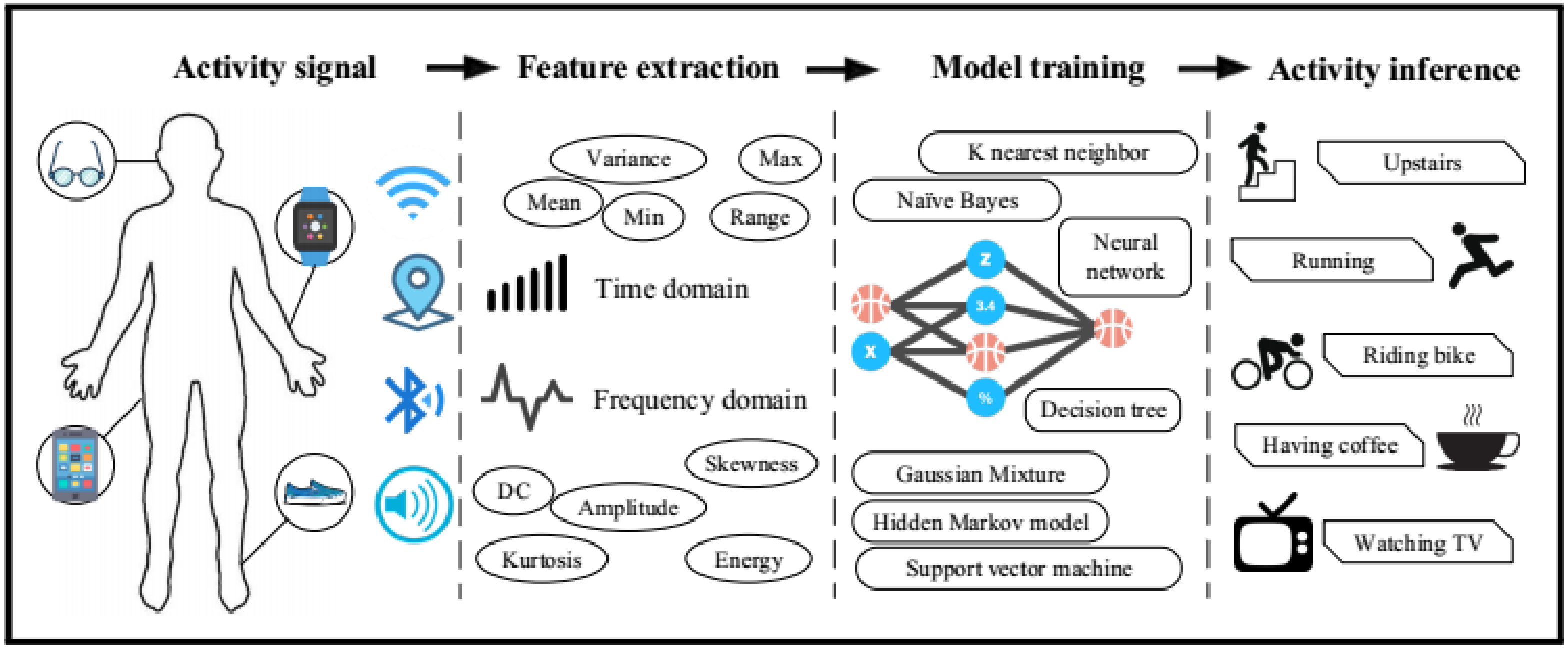
I'll see if I can find out.

I'm on it.

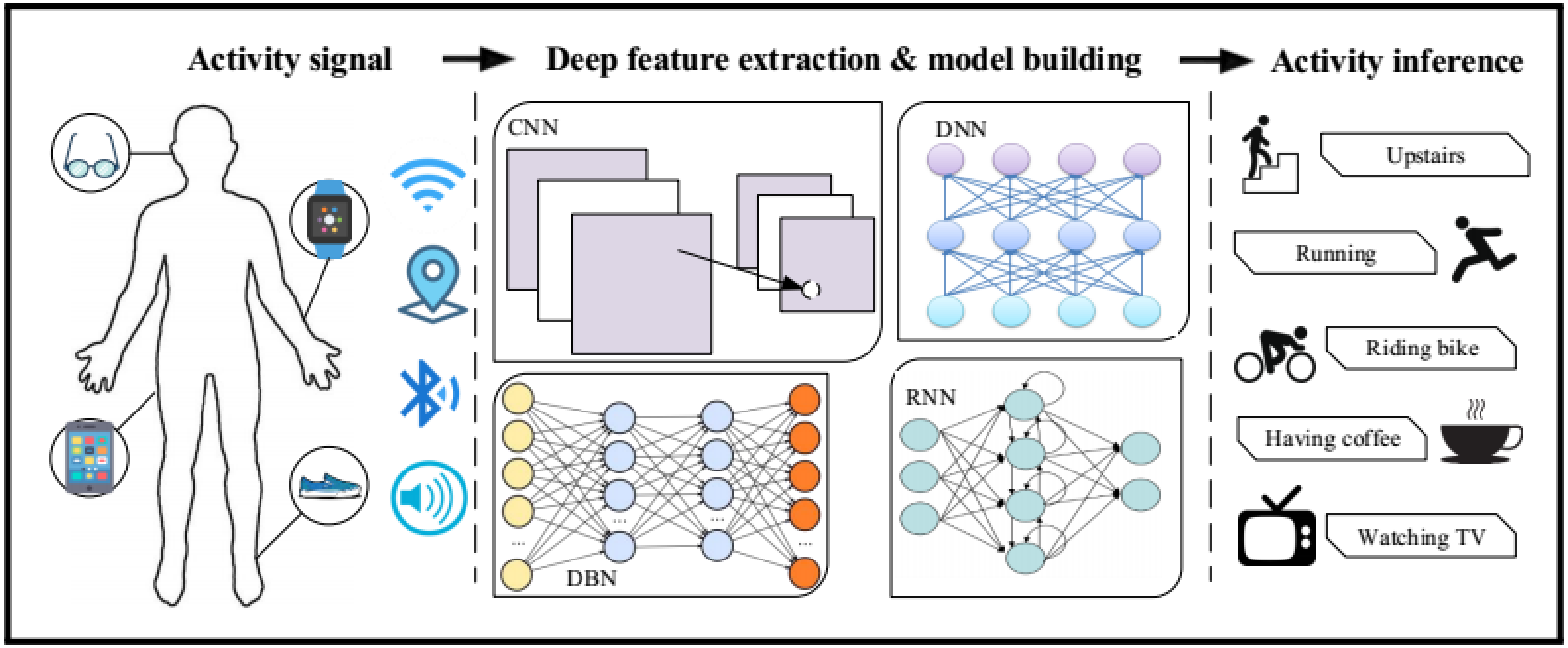
References

- *G. (2018, November 08). App Inventor for Android. Retrieved November 08, 2018, from https://en.wikipedia.org/wiki/App_Inventor_for_Android*
- *Magnuson, Bill. “Building Blocks for Mobile Games : A Multiplayer Framework for App Inventor for Android.” DSpace@MIT, Massachusetts Institute of Technology, 1 Jan. 1970, dspace.mit.edu/handle/1721.1/61253#files-area.*
- *Wolber, David; Abelson, Hal; Spertus, Ellen; Looney, Liz (May 2011), App Inventor for Android: Create Your Own Android Apps, O'Reilly, ISBN 978-1-4493-9748-7*
- *Hardesty, Larry (August 19, 2010). "The MIT roots of Google's new software". MIT News Office. http://news.mit.edu/2010/android-abelson-0819*
- *Esteva, Andre, et al. "Dermatologist-level classification of skin cancer with deep neural networks." Nature 542.7639 (2017): 115.*
- *Redmon, Joseph, et al. "You only look once: Unified, real-time object detection." Proceedings of the IEEE conference on computer vision and pattern recognition. 2016.*

Sensor Data : Machine Learning



Using Deep Learning model


Activity signal
Deep feature extraction & model building
Activity inference
CNN
DNN
DBN
RNN
Upstairs
Running
Riding bike
Having coffee
Watching TV